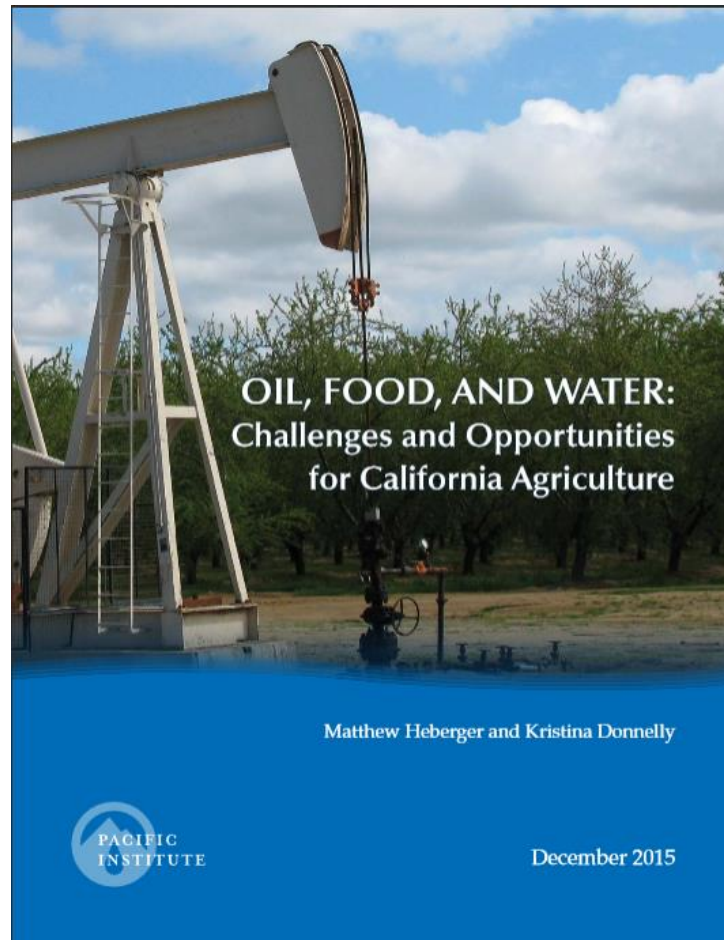


# Oil, Food, and Water in California



Matthew Heberger, Pacific Institute  
Presentation to Food Safety Advisory Committee  
January 12, 2016

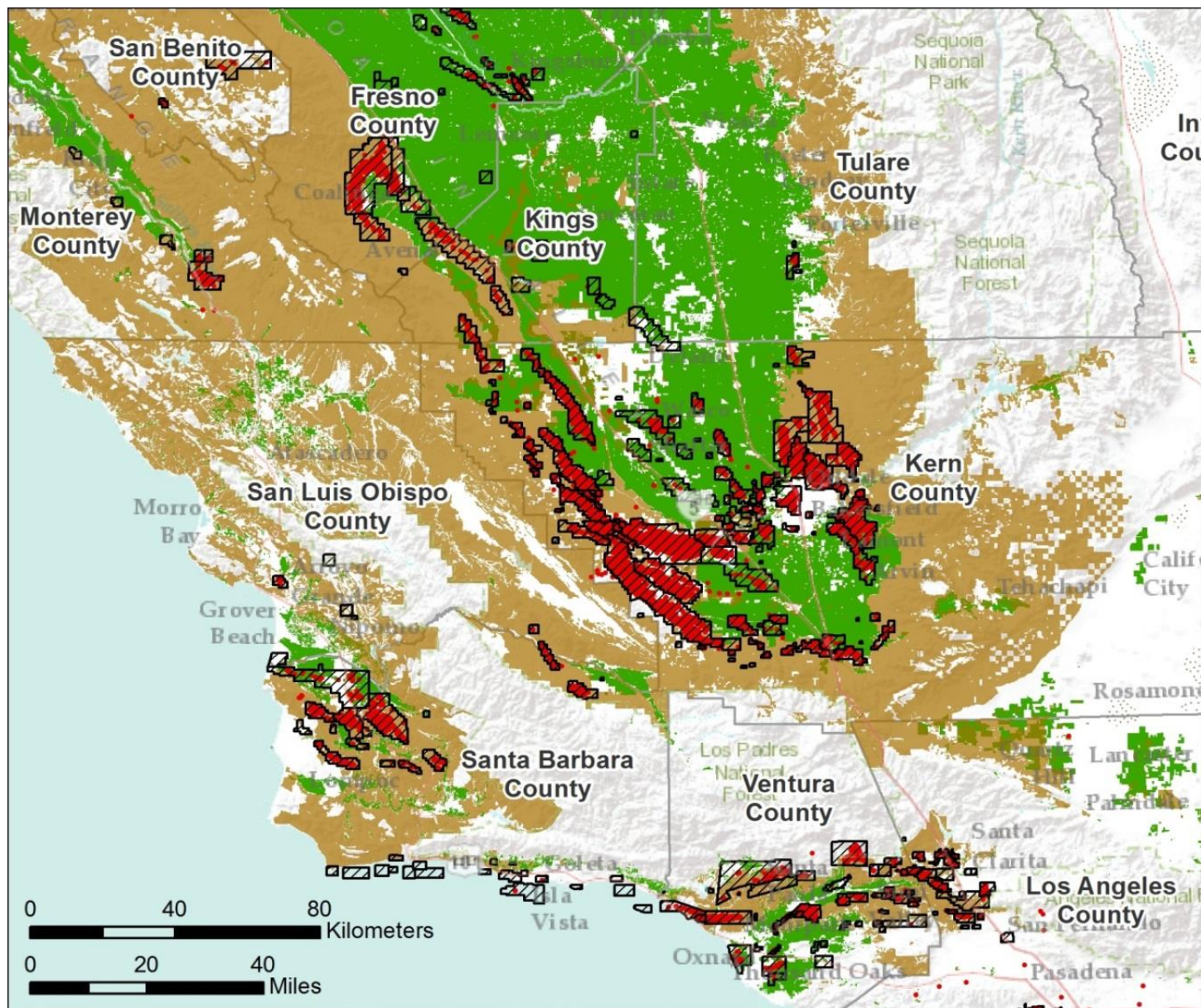


# Oil, Food, and Water

- The Pacific Institute is an independent, nonprofit research organization
- Study conducted over several months in 2015, published in December.
- Available for free at [www.pacinst.org](http://www.pacinst.org).
- Analyzes both the challenges and opportunities when the increasingly strained relationship between two of California's largest and most important industries
- We recommend a number of policy reforms to protect CA's agriculture and food systems, from farmworkers to consumers

# Key Findings

- Oil and gas exploration and production present many risks and some opportunities for California food and agriculture.
- O&G may compete for land and water with agricultural, municipal, or domestic water users.
- Most important issue: Pollution due to spills, leaks, or disposal of oilfield wastes can contaminate soil and water.
- Effect of chemicals on farmworkers, livestock, crops, food, and consumers largely unstudied and unknown.



-  Oil & Gas Fields
-  Active Oil and Gas Wells
-  Agricultural Land Use
-  Grazing Land
-  County Boundaries



# Oil and Ag in Close Proximity

**Table 1.**

**Proximity of active oil and gas wells to cropland in the San Joaquin Valley and Southern California.**

Minimum distance from cropland	Cumulative number of active oil and gas wells	Percent of active oil and gas wells
On cropland	1,942	3%
1 mile	13,926	23%
3 miles	31,168	52%
5 miles	55,745	93%
8 miles	59,840	100%

# Risk: Chemical Use

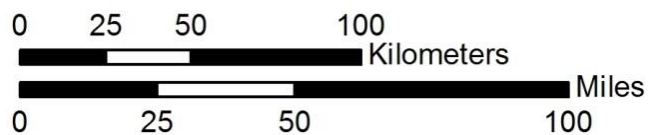
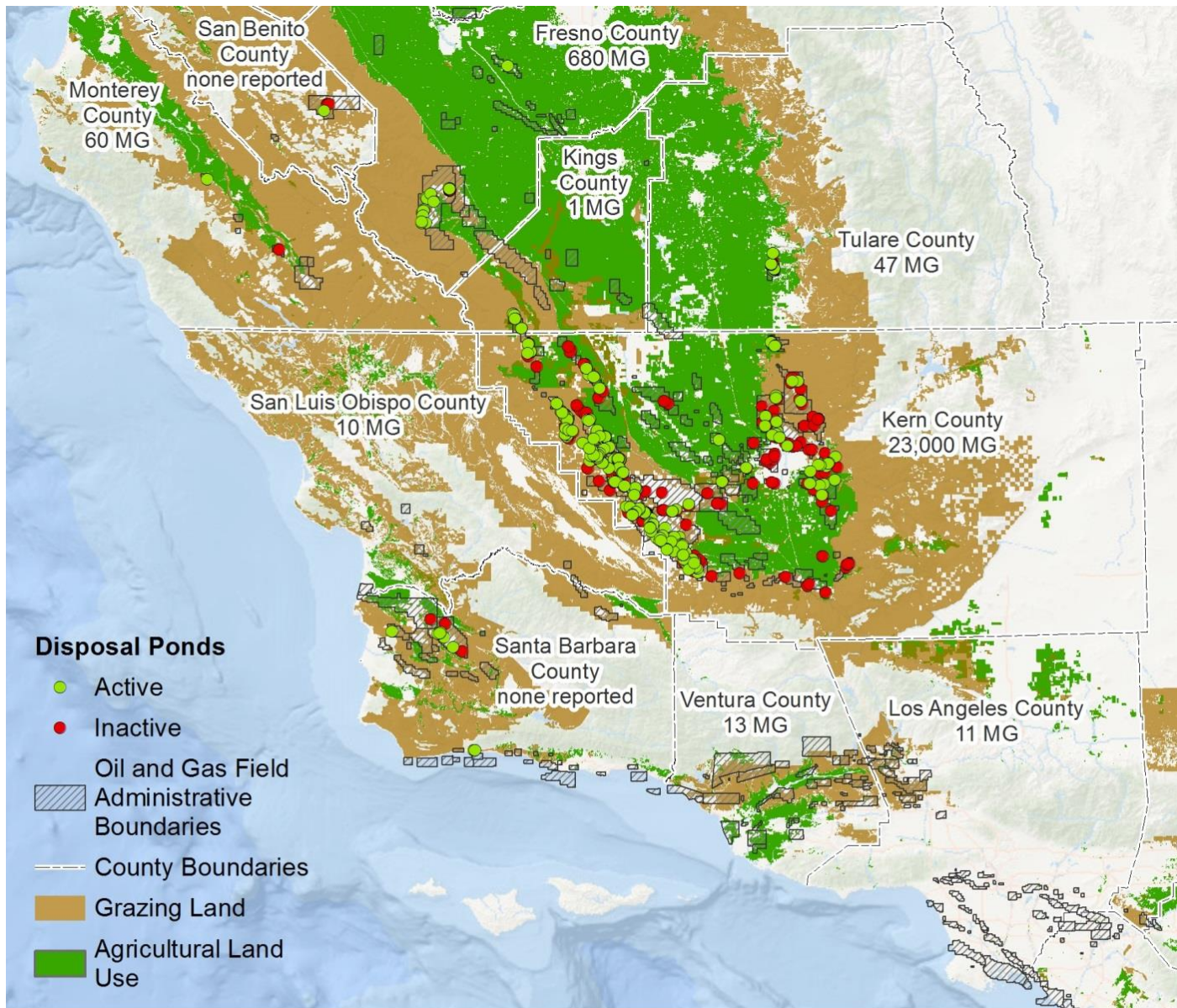
- Oil and gas production uses hundreds of different chemicals, some of which are known to be harmful.
- ~300 chemicals used for hydraulic fracturing and other stimulations
  - 28% are **unknown**: “trade secrets, confidential business information, or proprietary information”
  - For 1/3, **acute** toxicity unknown
  - For 4/5, **chronic** toxicity unknown

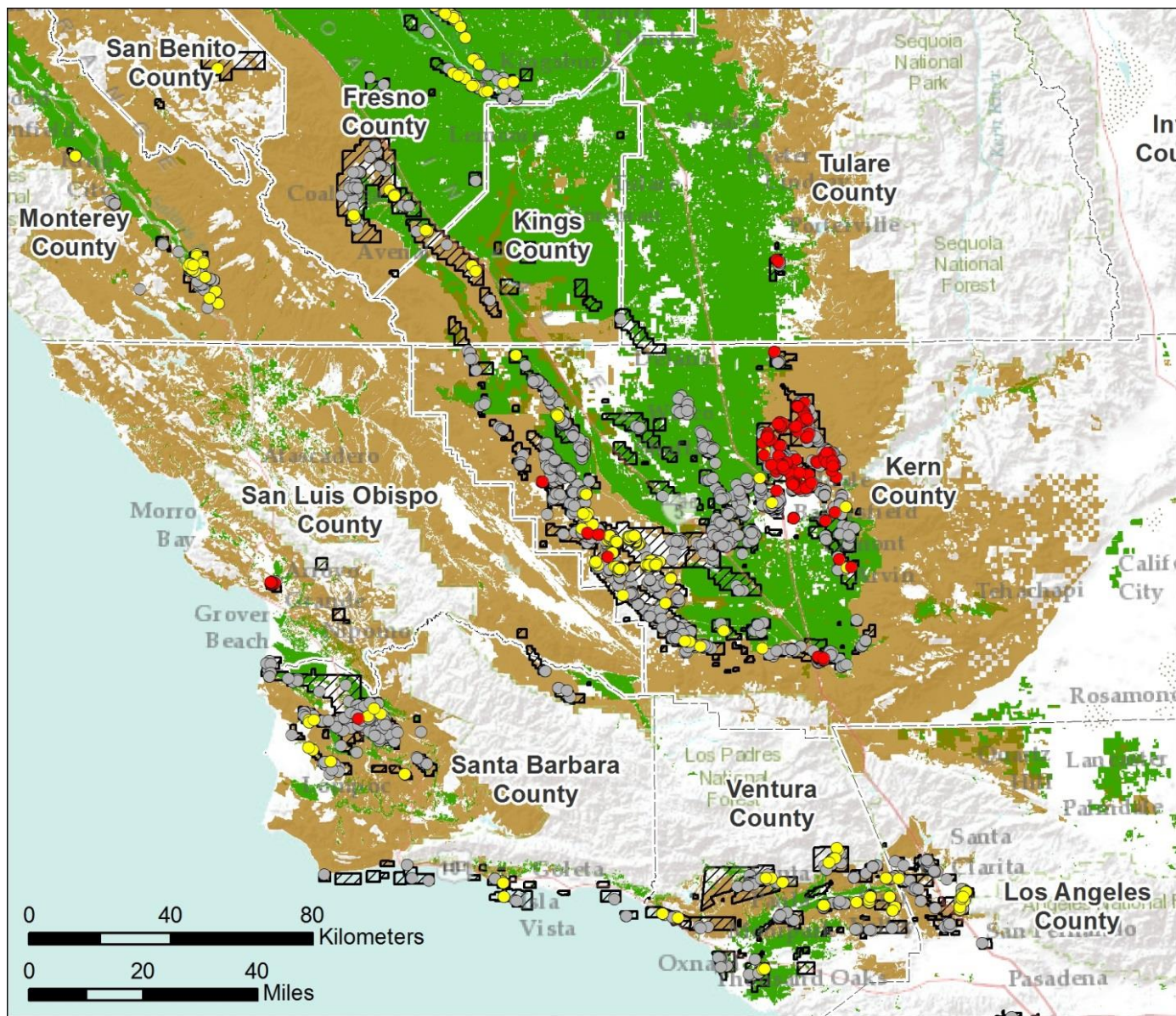
# Risk: Chemicals in Produced Water

- Oil wells in California generate on average 15 barrels of water for every barrel of oil.
- Produced water:
  - Salts
  - Metals (arsenic, lead, mercury)
  - Traces of oil
  - Polynuclear aromatic hydrocarbons (PAHs),
  - Volatile organic compounds (VOCs)
  - BTEX: benzene, toluene, ethylbenzene, and xylenes
  - Radionuclides

# Fracking in California

- Promise/threat of fracking-enabled shale boom is largely over.
- Since 2005, about ½ of all new oil wells are fracked, average of 150 fracks per month.
- Fracking occurs mostly in/around existing oil fields
- Concerns related to shallow fracking, new drilling on prime farmland in some areas.
- Additional concerns related to chemical use/disposal, pathways to shallow groundwater.





- 176 wells injecting to zones where TDS < 3,000 mg/L
- 532 wells injecting in non-oil zones
- 2,912 disposal wells (active & retired)
- ▨ Oil & Gas Fields
- ▬ County Boundaries
- Grazing Land
- Agricultural Land Use

# Opportunity: Reuse of Treated Oilfield Wastewater

- Currently, 9 projects using water from 5 oil fields, and more likely.
- Chevron Kern River project: 21 million gallons of water per day, or 24,000 acre-feet per year, about 50% of water supply to the Cawelo Irrigation District.
- About 1% of irrigation water in Kern County but could theoretically make up 12% if ALL produced water were reused.
- Other projects (Salinas, Ventura Co.) are “indirect” reuse: wastewater discharged to stream or infiltrated into groundwater, then used by downstream irrigators.

Table 3.

Projects where oil-field wastewater is permitted for reuse for crop irrigation in California.

Date permitted	County	Oil field	Operator	Permitted Volume (acre-feet per year)	Water treatment	Blending	Application	Crops irrigated	User	Data source
	Tulare	Deer Creek			Mechanical separation with addition of coagulants	No	Irrigation	Alfalfa	Private land	1
	Tulare	Deer Creek			Mechanical separation with addition of coagulants	No	Irrigation	Alfalfa	Private land	1
	Kern	Jasmin			Mechanical separation with addition of coagulants	Blended with canal water some of the time	Irrigation	Citrus	Jasmin Ranchos Mutual Water Company	1
	Kern	Mount Poso					Irrigation		Cawelo Water District	1
2012	Kern	Kern River	Chevron	37,500	Mechanical separation, sedimentation, air flotation, and filtration (walnut hull filters)	Treated wastewater, imported surface water, groundwater	Irrigation, groundwater recharge	99% permanent crops (citrus, almonds, pistachios, apples, peaches, plums, and vineyards); 1% (alfalfa, potatoes, corn, grains, vegetables, melons)	Cawelo Water District	1, 2
2012	Kern	Kern Front	California Resources Corporation	16,600		Treated wastewater, imported surface water, groundwater	Irrigation, groundwater recharge	Same as above	Cawelo Water District	1, 4
2011	Kern	Kern Front	Hathaway LLC	70	No treatment requirements	7% wastewater; 93% groundwater	Irrigation; during non-irrigation season, disposed of via underground injection	Citrus	Concordia Ranch	3, 7

**Table 3. (continued)**

Date permitted	County	Oil field	Operator	Permitted Volume (acre-feet per year)	Water treatment	Blending	Application	Crops irrigated	User	Data source
2015	Kern	Kern Front	California Resources Corporation	21,200	Gas separation, free-water knock-out tanks, air flotation, and skimming	Produced water, surface water, and groundwater blended in the Lerdo Canal	Irrigation, groundwater recharge in the Rosedale Basin	80% permanent crops of nuts, vineyards, and fruit	North Kern Water Storage District	5
2014	San Luis Obispo	Arroyo Grande	Freeport-McMoran Price Canyon	940	Mechanical, chemical, reverse osmosis	Yes (indirect reuse)	Discharged to Pismo Cree to improve habitat and water quality in the creek. Water in the creek is recharging groundwater and reused indirectly by downstream irrigators with wells.	Vineyards, row crops	Private land	6

Notes: Blanks indicate unknown or missing data.

Sources:

- (1) Email to the authors from Dane Johnson, Senior Engineering Geologist, Central Valley Regional Water Quality Control Board, 2014.
- (2) Central Valley Regional Water Quality Control Board (CVRWQCB). (2012). Waste Discharge Requirements for Chevron USA, Inc., and Cawelo Water District, Produced Water Reclamation Project, Kern River Area Station 36, Kern River Oil Field, Kern County. [http://www.waterboards.ca.gov/centralvalley/board\\_decisions/adopted\\_orders/kern/r5-2012-0058.pdf](http://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/kern/r5-2012-0058.pdf)
- (3) CVRWQCB. (2011). Conditional Waiver of Waste Discharge Requirements and Monitoring and Reporting Program for Hathaway, LLC Reuse of Oil Field Production Wastewater for Irrigation. [http://www.waterboards.ca.gov/centralvalley/board\\_decisions/tentative\\_orders/1110/hathaway/3\\_hathaway\\_waiver\\_res.pdf](http://www.waterboards.ca.gov/centralvalley/board_decisions/tentative_orders/1110/hathaway/3_hathaway_waiver_res.pdf)
- (4) CVRWQCB. (2012). Order No. R5-2012-0059 Waste Discharge Requirements for Valley Water Management Company and Cawelo Water District, Produced Water Reclamation Project, Kern Front No. 2 Treatment Field, Kern Front Oil Field, Kern County. [http://www.waterboards.ca.gov/centralcoast/board\\_decisions/adopted\\_orders/2013/2013\\_0029\\_freeport\\_npdes\\_permit.pdf](http://www.waterboards.ca.gov/centralcoast/board_decisions/adopted_orders/2013/2013_0029_freeport_npdes_permit.pdf)
- (5) California Regional Water Quality Control Board, Central Valley Region Monitoring And Reporting Program, No. R5-2015-XXXX for California Resources Corporation, LLC And North Kern Water Storage District, Oil Field Produced Water Reclamation Project, Kern County. [http://www.waterboards.ca.gov/centralvalley/board\\_decisions/tentative\\_orders/calrescorp/crcnkwsd\\_mrp.pdf](http://www.waterboards.ca.gov/centralvalley/board_decisions/tentative_orders/calrescorp/crcnkwsd_mrp.pdf)
- (6) CVRWQCB. "Notice Tentative Waste Discharge Requirements for California Resources Corporation, LLC and North Kern Water Storage District Oil Field Produced Water Reclamation Project Kern County," September 18, 2015. [http://www.waterboards.ca.gov/centralvalley/board\\_decisions/tentative\\_orders/calrescorp/crcnkwsd\\_cov.pdf](http://www.waterboards.ca.gov/centralvalley/board_decisions/tentative_orders/calrescorp/crcnkwsd_cov.pdf)
- (7) California Regional Water Quality Control Board, Central Valley Region Monitoring and Reporting Program, R5-2011-XXXX for Hathaway, LLC, Reuse Of Oil Field Production Wastewater for Irrigation, Kern Front Oil Field, Kern County. [http://www.waterboards.ca.gov/rwqcb5/board\\_decisions/tentative\\_orders/1110/hathaway/4\\_hathaway\\_mrp.pdf](http://www.waterboards.ca.gov/rwqcb5/board_decisions/tentative_orders/1110/hathaway/4_hathaway_mrp.pdf)

# Wastewater Reuse (cont.)

- Federal Clean Water Act covers oil and gas wastewater. Illegal in eastern US. West of 98<sup>th</sup> meridian,
- Water quality standard for “wildlife and agricultural use:” must not have more than 35 mg/L of oil.
- Standard developed 40 years ago, based on the “best practicable control technology” at the time.
- Permits in California issued by 9 Regional Water Quality Control Boards with differing requirements.
- No state agency responsible for assuring safety of irrigation water or the food supply.
- Organic certification does not set standards for source or quality of irrigation water.

# Risk: Chemical Uptake by Crops

- No studies have been done to evaluate the uptake or accumulation of chemicals in oilfield wastes in food crops; evidence from related studies gives cause for concern.
- Some compounds broken down or immobilized by soil or microbes. Others excluded by plant roots or cell membranes.
- Some plants can readily absorb toxins *without* transferring them to the leaves or the flesh of their fruit.

# Chemical Uptake by Crops (cont.)

- Study in the UK found nonylphenol polyethoxylates (NPEOs) accumulate in bean plants
  - These chemicals are endocrine disruptors, known to affect aquatic organisms
  - Banned in Europe, but used in well stimulation in California over 50 times in the last 5 years
- Heavy metals accumulate in the edible parts of vegetables and grains, at levels that are cause for health concern when they are consumed regularly
- Metals in produced water (lead, arsenic, cadmium, chromium, and mercury) do not degrade over time, but may be bound to soil particles.

# Risk: Harm to Livestock



# Risk: Harm to Livestock

- Hydrocarbons and other constituents found in oilfield waste are harmful to exposed livestock.
- Livestock poisoning has been observed from ingestion crude oil, condensate, salt water, heavy metals, caustic chemicals, and fracking fluid.
- Guidelines exist to prevent sickening or death of animals.
- Unknown effects on the food supply: meat, eggs, or dairy products.

# Risk: Harm to Farmworkers

- Those who live and work in nearby communities bear the most direct burden.
- Potential exposure from unclean water, air pollution (inhalation or skin absorption of volatile chemicals).
- The effects on farmworkers are unstudied and unknown.
- Cal/OSHA should conduct a risk analysis, and if exposure pathways are found, identify how to avoid or lessen workplace exposures.
- Employers should better communicate potential chemical hazards to employees.

# Risk: Public Perception

- 53% of American consumers “frequently wonder if the food they buy is safe”
- Recent articles and blog posts show that many do not want food that has been exposed to oilfield wastes or fracking chemicals

# Key Recommendations

- There needs to be better oversight and regulation of waste disposal by the oil and gas industry
- California should ban unlined percolation pits for the disposal of oilfield wastewater.
- Legislature should assemble an expert scientific panel to analyze the safety of recycling oilfield wastewater for crop irrigation.
- Raise bonding requirements for new wells and consider an oil severance tax to cover costs of well closure and cleanup.

# Sewage Reuse



# Sewage Reuse



# Parallels with Regulation of Sewage Reuse

- Municipal wastewater recycling in California is regulated by Title 22 of the California Code of Regulations, which establishes water quality standards specific for different uses
- Comprehensive policy for water reuse, including uniform statewide rules, developed in 2008 by the State Water Board and the Department of Public Health.
- Guidelines include detailed treatment, testing protocols matching water quality to use:
  - fodder crops, non food-bearing trees, sod farms, etc.
  - crops where the edible portion is above ground and does not contact the recycled water, pasture for animals producing milk
  - food crops where the recycled water comes into contact with the edible portion of a food crop eaten raw).

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